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A SKETCH OF THE FLORA OF SOUTHERN CALIFORNIA.

S. B. PARISH.

THE name "Southern California" is here restricted to a territory somewhat less extensive than that to which it is sometimes applied; but even as here limited, to the five southernmost counties—Los Angeles, San Bernardino, Riverside, Orange, and San Diego—it includes one quarter of the area of the whole state, and exceeds in size the great state of Ohio. It has an area of 40,889 square miles (over 100,000 sq. kilometers). Its greatest breadth, from north to south, is 210 miles (336 km), and from east to west 282 miles (451 km). It lies between 32° 30′ and 35° 40′ north latitude, and between 37° 15′ and 42° longitude west from the meridian of Washington. Its western boundary is formed, for the greater part, by the Pacific Ocean, but partly by the counties of Ventura and Kern, and these two counties, together with Inyo, bound it on the north, while for a short distance on the northeast it touches the state of Nevada. The river Colorado separates it on the east from Arizona, and on the south it adjoins the Mexican state of Lower California.

Before proceeding to a consideration of the flora of this region it is desirable to speak briefly of the physical character of its surface, and of its climate, since these are the most important influences by which the development and distribution of its plant population have been determined.

OROGRAPHICAL FEATURES.

The region is one of mountains, whose ramifications embrace numerous valleys of greater or less extent. The main axis of upheaval is a continuation of the Sierra Nevada. It enters our region at Ft. Tejon, in which neighborhood the Coast Range unites with it; and it extends in a course from northeast to southwest, culminating in the twin summits of San Bernardino and Grayback, respectively 10,100 ft (3,080 m) and 11,725 ft

(3,575$^{\mathrm{m}}$) above sea level. The mountains between these limits are generally called the San Bernardino Range.[1] It is made up of the Sierra Liebre and Sierra Pelona, between Tejon and Soledad Passes; the San Gabriel Mountains, with the peaks of San Gabriel, 6,232$^{\mathrm{ft}}$ (1,900$^{\mathrm{m}}$), San Antonio, 10,120$^{\mathrm{ft}}$ (3,085$^{\mathrm{m}}$), and Cucamonga,[2] 6,500$^{\mathrm{ft}}$ (1,980$^{\mathrm{m}}$), between Soledad and Cajon Passes; and the San Bernardino Mountains proper, between Cajon and San Gorgonio Passes.

North of Soledad Pass the mountains are comparatively low, but rugged and broken. An important cross range, the Santa Monica, maintaining an altitude of 2,000 to 3,000$^{\mathrm{ft}}$ (600–900$^{\mathrm{m}}$), stretches from San Fernando Peak, 3,793$^{\mathrm{ft}}$ (1,156$^{\mathrm{m}}$), to the Pacific Ocean at Point Duma. But south of Soledad the mountains become higher, towering up abruptly, from a valley base 500 to 1,000$^{\mathrm{ft}}$ (150–300$^{\mathrm{m}}$) above the sea, to a ridge line having an altitude of 5,000 to 6,000$^{\mathrm{ft}}$ (1,500–1,800$^{\mathrm{m}}$). From the desert they present a less lofty appearance, since on that side the base altitude is 3,000 to 3,500$^{\mathrm{ft}}$ (900–1,066$^{\mathrm{m}}$).

Grayback throws out an important spur, in the direction of the main range, towards the Colorado River. This may be known as the Chuckawalla Range, although that name is often restricted to its further extremity. It separates the Colorado and the Mojave[3] Deserts.

The low San Gorgonio Pass separates Grayback from San Jacinto Mountain 10,805$^{\mathrm{ft}}$ (3,993$^{\mathrm{m}}$), an air-line distance of some twenty miles. The mountains here spread out, their course changes, and is less defined. But regarding the line which divides the watershed draining into the Pacific from that which drains into the desert, its direction is found to be about 10°

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[1] First by Blake in Pac. R. R. Rep. 5. He also suggested the name "Peninsular Range" for the mountains extending from San Jacinto into Lower California, but this name, although appropriate, has failed to find acceptance.

[2] This was a troublesome name to the early explorers. It is Quiqual Gungo of Pac. R. R. Rep. 4 : 38; Quiquai-mungo *ibid.* 5^{2} : 80; and Kikal Mungo *ibid.* 7 : 8.

[3] I use the spelling long current in California. While only the Spanish orthography of an aboriginal name, it harmonizes with such Spanish names of the region as Tejon, Cajon, etc. The U. S. Board on Geographical Names has adopted the form "Mohave," but this should not be allowed to supersede a well-established local usage. The name was first printed by Fremont in 1844, who spelled it "Mohahve."

south of east. Here it is the desert face which is precipitous, its base, for the most part, not exceeding 500$^{\text{ft}}$ (150$^{\text{m}}$) above sea level, while upon the other side San Jacinto overlooks a confusion of ridges and lesser peaks.

A main cross-range from San Jacinto parallels the San Bernardino Mountains at a distance of about forty miles. It comprises the Palomar Mountains[4] (summit 5,800$^{\text{ft}}$, 1,765$^{\text{m}}$) and the Temescal Mountains, whose terminal summit, Santiago Peak,[5] has an altitude of 5,675$^{\text{ft}}$ (1730$^{\text{m}}$), and separates the San Jacinto Valley from the coast region.

Further south Cuyamaca Mountain, 6,500$^{\text{ft}}$ (1,980$^{\text{m}}$) high, dominates a rugged region of high ridges and narrow valleys. In default of a better name the entire chain, from Tejon Pass to Cuyamaca, may be called the Nevadan Range, since it is, in truth, a part or a continuation of the Sierra Nevada.

THE DESERTS.

The topography of the desert region is less accurately known. It comprises two distinct divisions: the Colorado Desert and the Mojave Desert. The former, stretching southeastward from San Gorgonio Pass to the Mexican boundary, is a great valley, 180 miles (288$^{\text{km}}$) long, and 30 to 50 miles (50–80$^{\text{km}}$) wide. In its center it sinks into a deep depression over 250$^{\text{ft}}$ (76$^{\text{m}}$) below sea level,[6] the dry bed of what has been in prehistoric times first an arm of the sea, and later a fresh or brackish lake. In this depressed area, and notably near Salton, volcanic forces yet manifest themselves in "mud volcanoes" and extensive solfataras.

The lower part of this desert, toward Yuma, and in the New River region, consists largely of pebble-covered clay plains and shifting sand hills, and has an altitude of 150 to 400 ft (45–120 m). The area of the Colorado Desert has been estimated at 9,000 square miles (14,400 sq km).[7]

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[4] Also known as Smith Mountains.

[5] Sometimes called Saddleback, or Santa Ana peak. In 1861 Dr. Whitney gave it the name Mt. Downey, which fortunately has never been accepted. This whole range is often called the Coast Range, but it has no connection with the true Coast Range of California.

[6] The following are the altitudes in feet at stations on the Southern Pacific Railway where it crosses this depression: Seven Palms, 582; Indio, −20; Walters, −195; Dos Palmas, −253; Salton, −263; Flowing Well, 5; Tortuga, 185. The total distance, in a straight line, is about 80 miles (130$^{\text{km}}$).

The Mojave Desert lies on the north side of the San Bernardino Range, and its continuing spur, the Chuckawalla Mountains; eastward it stretches to the Colorado River, and northerly to and beyond our boundary lines. Its greatest length, east and west, measured in an air-line, from Gormans Station, at the head of Antelope Valley, to the Needles on the Colorado River, is about 130 miles (210 km). Its width, north and south, from the mountains which form its southern rim to our northern boundary, varies from 30 to 60 miles (48–96 km). No estimate of its area appears to have been made. Within our limits its altitude is much greater than that of the Colorado Desert, being 2,000 to 3,500 ft (660–1,067 m), but beyond them it also sinks, in Death Valley, below sea level.

Its whole surface is cut up by short isolated ranges and "lone mountains," which are surrounded by sloping mesas, or enclose basins whose lowest portions are occupied by "dry lakes." Some of these are level expanses of hard, elastic clay, smooth and bare as a racetrack, and bordered by a narrow belt of nitrophilous vegetation. Receiving the scanty storm water that rolls down from the bare hills about them, they at times may be transformed into tenacious mud, or even be covered by a few inches of water. Or the floor of these basins may consist of what prospectors call "self-rising soil," a deep bed of loose alkaline powder, slightly crusted over, into which foot and wheel sink wearily; or, again, it may be covered with a snowy incrustation of soda salts.

The highest mountain of the Mojave Desert is Ivawatch, 6,290 ft (1,917 m), on the northern boundary of San Bernardino county. Some twenty miles southwest is Pilot Knob, 5,525 ft (1,684 m), a noted landmark, as its name indicates. Mt. Manchester, near the Needles, is 4,570 ft (1,448 m) high. But the most important of these ranges are the Providence Mountains, situated on the eastern border of the desert, and extending some 75 miles (120^{km}) in a NNE and SSW course, culminating at the south in Mt. Edgar, $6,350^{ft}$ ($1,935^{m}$).

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[7] This is for the part of it within the United States; beyond the boundary it continues to the Colorado River and the head of the Gulf of California. Its width on the Colorado River is fully 75 miles (120 km).

DRAINAGE SYSTEMS.

A country such as I have described, if in a region of abundant rainfall, would abound in limpid lakes, and in living streams, some of which would be of considerable volume But far other is the case under the arid conditions which here exist. Even the streams rising in the high mountains of the San Bernardino range are infrequent, slender and inconstant; and of still less importance are those which drain the mountains to the south. In seasons of unusual precipitation they become raging torrents, and at such times the larger streams may carry their waters to the sea; but ordinarily their volume is insufficient to reach their nominal mouths, while in summer they dwindle down to thin rivulets which repeatedly sink and reappear in their wide sandy beds.

The San Gabriel Mountains give rise on their desert slopes to Rock Creek,[8] which ventures beyond their base only in wet weather. On their seaward side they are drained on the west by the Los Angeles and San Gabriel Rivers, and on the east by Lytle Creek, a tributary of the Santa Ana.

The San Bernardino Mountains furnish the waters of the most important streams of the whole region. On the northern watershed the Mojave River has its source in Holcomb Valley, at an altitude of $7,000^{ft}$ ($2,134^{m}$). It flows 75 miles (120^{km}) in a northerly direction, and then turning to the east continues for 60 miles (96^{km}) further, the distances being measured in an air line, but following its meanderings its length is fully 200 miles (320^{km}). In its course it disappears eight times in its sandy channel, leaving it entirely dry for long intervals, and is finally lost in Soda Lake (alt. $1,116^{ft}$, 340^{km}), a flat, elliptical depression some 70 square miles ($112^{sq\,km}$) in area, occasionally flooded a few inches deep with water, but usually whitened with alkaline efflorescences. The eastern drainage of these mountains forms the Arroyo Blanco, or Whitewater, a strong stream which is soon lost in the sands of the Colorado Desert.

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[8] This is the "Johnson's River," of Blake, Pac. R. R. Rep. 5:30 *et seq.*

The Santa Ana River carries the seaward drainage, and has an airline course of 85 miles (136^{km}), in a southwest direction, to the ocean, which, it is said, its waters have been known to reach in high floods. In ordinary stages it sinks soon after disemboguing from the mountains, and reappearing after ten miles (16^{km}) carries more or less water nearly to Santa Ana.

San Jacinto Mountain gives rise to a stream bearing the same name, which follows a southwest course to Elsinore Lake. Its channel, however, is only intermittently supplied with surface water. The Santa Margarita, the San Luis Rey, the Sweetwater, and some lesser streams, drain the mountains of San Diego county, and have a character similar to those already described.

The Colorado River, which touches the border of the state, does not receive from it a single tributary, great or small; but an abandoned channel, the so-called New River, carries the waters of the Colorado, in times of great floods, into the southeastern part of the desert and to the Salton Sea.

GEOLOGICAL FORMATIONS.

The great mountain axis consists principally of granitic formations, and such is the prevailing character of the subordinate ranges. There are occasional outcroppings of limestones, but always of limited area. A range of Tertiary hills, conglomerates, sandstones and shales, beginning near Pasadena, stretches to the Santa Ana River, where it is divided by the granites of the Temescal Mountains, a narrow arm continuing along their northeastern base, while a wider one (10–18 miles, $16–29^{km}$) turns toward the coast, which it reaches at San Juan, and follows it thence to the Mexican boundary. A less important Tertiary formation skirts the southern base of the San Bernardino Mountains from Santa Ana Cañon to the Whitewater, occupying an area of 30 miles (48^{km}) in length by 1 to 5 miles ($1.6–8^{km}$) in width. The same formation also appears in the Palos Verdes hills, and on the islands off the coast.

The San Fernando Plains, the wide expanse of fertile country between Los Angeles and Santa Ana, the San Bernardino, San Jacinto, and many smaller valleys are Quaternary and Recent. They include sandy and gravelly mesas, as well as rich loams, ferruginous clays, and black adobe. Almost without exception they contain soda salts, from the small percentage which increases fertility, to the excess which forbids the growth of all but a few specialized plants. Recent formations also prevail throughout the Colorado Desert.

The formations of the Mojave Desert are less well known. The mountains are, for the most part, granitic, the intervening mesas and valleys being of recent deposition. Evidences of former volcanic activity are exhibited in places. This is most marked in the country between Point of Rocks and Bagdad, on the Santa Fé Railway, an air-line distance of some 80 miles (130^{km}). Here the rocks are metamorphosed, and often display commingled bands and patches of reds, blues, greens, purples and yellows.[9] The mesas are strewn with scoria, the hills have black lava caps, fissure lines are seen, and lava streams may be traced for miles. Not less than a dozen volcanic cones are known in this region. One of the largest is 450^{ft} (137^{m}) high and $3,000^{ft}$ (914^{m}) in diameter at base; the extinct crater at the summit is 750^{ft} (228^{m}) in diameter and 150^{ft} (45^{m}) deep. The Providence Mountains limit this volcanic area on the east, but northward other less known centers exist.

CLIMATIC CHARACTERISTICS.

Southern California possesses a variety of climates, but throughout the larger part of it aridity and high temperature are the dominant features. There are few, if any, absolutely frostless localities, but there are many where only light frosts ever occur, and which may be quite untouched for several successive years. At altitudes below $1,500^{ft}$ (457^{m}) the midwinter temperature rarely falls below 25° F. (−4° C.), and the same altitude marks the ordinary limit of even light snowfalls.

But ascending to higher altitudes a different climate and a cooler temperature is soon reached. Thus at San Bernardino

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[9] This peculiar coloration gave the Calico Mountains their prosaic name, in reference to their variegated tints.

(1,075$^{\text{ft}}$, 328$^{\text{m}}$) in the five years 1895–9 the highest point reached by the thermometer was 110° F. (43° C.) and the lowest 23° F. (− 5° C.).[10] At Little Bear Valley, 5,150$^{\text{ft}}$ (1,569$^{\text{m}}$), in the adjacent mountains, distant about 12 miles (20$^{\text{km}}$) in an air line, the extremes during the same years were 93° and −2° F. (34 and −19 C.).[10a] That is, a temperature was reached in summer in the valley 17° above that of the mountain, while the winter temperature lacked 21° of falling so low. At Big Bear Valley, 6,500$^{\text{ft}}$ (1,981$^{\text{m}}$) a temperature of −14° F. (−25.5° C.) has been observed,[11] frosts occur in midsummer, and ice sometimes forms on an August night. No observations have been made at greater altitudes, but it is evident that at 10,000 or 12,000$^{\text{ft}}$ (3,000–3,600$^{\text{m}}$) very low temperatures must be reached. These lofty summits are white in the winter months, and on their northern slopes the snow fields often linger late into summer. After a winter of unusual accumulations some shrunken remains may even persist into a second season.[12] Even at altitudes as low as 6,000–7,000$^{\text{ft}}$ (1,830–2,130$^{\text{m}}$) there are sheltered cañons where snow banks yet linger at midsummer.

Contrary to common opinion, recorded observations establish the fact that lower temperatures are reached at stations in the desert region than at places having the same altitude on the seaward side of the mountains.[13] A great difference is shown also at the other extremity of the scale. The highest temperatures recorded on the coast are 85°–100° F. (30–38° C.); further back from the sea 100°–112° F. (38–44° C.) is reached; but at stations in the deserts records of 115°–128° F. (46–53° C.) have been made.[14]

The annual precipitation is very unequal in amount, not only in the different regions, but in the same region in different years. As an example of yearly variability the rainfall at Los Angeles of 32.25$^{\text{in}}$ (819$^{\text{mm}}$) in 1869 may be compared with that of 4.83$^{\text{in}}$ (122$^{\text{mm}}$) in 1898. In the desert region the rainfall is always very small, and in average seasons is greatly exceeded by that of the cismontane region, but years of extreme drought have occurred in which the difference was less marked.

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[10] From the Records of Dr. A. K. Johnson.

[10a] Records of Arrowhead Reservoir Co.

[11] Records of the Bear Valley Co.

[12] Mean annual snowfall at Little Bear Valley 1895–9, 73$^{\text{in}}$ (1,854$^{\text{mm}}$); greatest single snowfall, 39$^{\text{in}}$ (990$^{\text{mm}}$). Records of Arrowhead Reservoir Co.

[13] At Victor, in the Mojave Desert, altitude 2,713$^{\text{ft}}$ (828$^{\text{m}}$) killing frosts occur in August.

[14] At Mammoth Tank, July, 1887, 128° F.; July, 1884, 126° F.

The appended table exhibits the normal amount of precipitation at places whose records extend over a period of more than fifteen years. The average for the three intramontane stations is 14.95$^{\text{in}}$ (380$^{\text{mm}}$), or about five times that of the desert station.

NORMAL PRECIPITATION.

STATIONS	ALTITUDE		YEARS OF RECORD	MONTHLY PRECIPITATION				YEARLY PRECIPITATION	
				Least		Greatest			
	Feet	Meters		In.	Mm.	In.	Mm.	In.	Mm.
Los Angeles.....	270	84.1	21	T	T	4.0	102	18.1	460
San Diego.......	12	3.6	42	0.1	2.5	2.1	53	9.8	249
San Bernardino..	1,075	327.6	29	0.3	7.6	3.6	91	17.0	432
Yuma...........	140	42.7	16	T	T	0.6	15	3.2	77

Nearly as great a disparity exists between the rainfall of the intramontane and the Nevadan regions, but data from the latter are few and not easily obtained. A partial means of comparison is afforded by the following table. The seasons are from July to June. The distance of the two stations in an air-line is about 12 miles (20$^{\text{km}}$); the difference of altitude is 4,075$^{\text{ft}}$ (1,242$^{\text{m}}$).

PRECIPITATION FOR SIX SEASONS, 1893–94 TO 1898–99.

STATIONS	ALTITUDE		PRECIPITATION					
			Greatest		Least		Mean	
	Feet	Meters	In.	Mm.	In.	Mm.	In.	Mm.
San Bernardino[14].......	1,075	328	20.98	533	7.49	190	11.61	295
Little Bear Valley[15].....	5,150	1,570	60.61	1,542	19.79	502	33.08	840

The rainfall at the mountain station is nearly three times that of the subjacent valley. The seasons of greatest and least rainfall were synchronous.

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[14] Dr. A. K. Johnson's record.

[15] Arrowhead Reservoir Co.'s record.

But for the purposes of the present inquiry the extreme of moisture and drought to which plant life is exposed is of as great importance as the average amount of rainfall; and the distribution in time of this amount is a factor of equal value. Again it will be found that in these respects the desert vegetation is at a disadvantage. Throughout the deserts total yearly rainfalls of 1.5 to 4^{in} ($38–101^{\text{mm}}$) are the rule, and at some stations a whole year may pass with absolutely no measurable precipitation. But this small amount is so evenly distributed through the year as to produce much less effect, certainly for annual plants, than if it were concentrated in a few months. The table below shows the normal distribution of rainfall throughout the year at two desert stations, compared with that at two stations on the coast.

NORMAL MONTHLY PRECIPITATION IN INCHES.

STATIONS	Years	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Keeler	8	0.2	0.4	0.2	0.3	0.4	0.2	0.1	0.2	0.3	0.3	0.4	0.4	3.3
Yuma	16	0.4	0.6	0.2	0.1	T	T	0.1	0.4	0.1	0.3	0.3	0.6	3.2
San Diego	42	1.6	2.1	1.0	1.0	0.3	0.1	0.1	0.1	0.1	0.3	1.0	2.1	9.8
Los Angeles	21	3.9	4.0	2.2	1.3	0.3	0.1	T	0.1	T	0.7	1.6	3.7	18.1

It here appears that the scanty rainfall of the desert stations is quite evenly distributed through the whole year, while at San Diego 9.1 inches out of the total 9.8 inches, and at Los Angeles 17 inches out of 18.1 inches fell during the growing season between November and May. That is, over 95 per cent. of the total rainfall at these places comes at a time when, owing to a lower temperature and a more declined sun, it is not subject to rapid evaporation, and avails most for the growth of vegetation. On the other hand almost all the desert rainfall may be regarded as ineffective by reason of its equal distribution.

It must be remembered, however, that all our recorded observations were made at stations in the open deserts, whereas had they been made in the cañons of the circumscribing mountains, somewhat more favorable results would have been obtained.

The rainclouds hug the mountains, and in winter one often may pass from the bright sunshine of the desert valleys through mist and drizzle to heavy showers by ascending for a few miles some cañon leading up the mountains. Hence it is in the cañons that the botanist learns to expect the most abundant and varied vegetation.

The desert mountains are also the scenes in midsummer of "cloud-bursts," or violent thunderstorms. These discharge in a short period and over a limited area a great quantity of water, and for a few hours the parched cañons are filled with rushing torrents. I have found a measurement of but one of these "cloud-bursts," and that only partial. At Campo on a day in August, 1891, there fell in such a storm 16^{in} (406^{mm}) of rain, before the gauge was washed away, preventing a complete measurement.

On the seacoast the aridity of the atmosphere is modified by frequent fogs and damp air-currents from the sea; and these ameliorating influences extend their benefits, in a less degree, inland, but do not pass beyond the mountains to modify the dryness of the desert air, while the strong winds almost constantly blowing there, produce a further desiccating effect.

PHYTOGEOGRAPHICAL AREAS.

It will readily be understood, from the preceding account, that the region under consideration consists of three divisions, differing from one another in both topography and climate. Consequently each of these will be found to possess a distinct and characteristic flora, and to constitute a separate life area.

In its relation to the biological divisions proposed by Dr. Merriam[16] the entire territory may be regarded as a part of the Sonoran province, in the midst of which arise two isolated peaks belonging to the Boreal province. A scanty Arctic flora occupies the summits of these peaks, and beneath it a diligent study can disentangle the Hudsonian and Canadian zones. This has been worked out very carefully and thoroughly by Mr. H. M. Hall,[17] for San Jacinto, one of these mountains; the other, San Bernardino, yet awaits such detailed study.

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[16] MERRIAM, J. HART, N. Am. Fauna 3:20, map 5; National Geo. Mag. **6**:229; Yearbook U. S. Dept. Agr. **1897**:203.

[17] HALL, HARVEY M., A botanical survey of San Jacinto Mountain. Univ. of Cal. Pub. Bot. **1**:1–144.

But as might be expected from the position of the mountain chain, narrow and between two hot and arid districts, the zonal differentiation is not here carried out to the extent, or with the distinctness, that is exhibited in mountains more favorably situated, and of greater area. Indeed, the commingling of the Hudsonian and Canadian with the Neutral (*Pinus ponderosa*) belt is a marked feature of these mountains.

While, therefore, in a detailed study the separation of these zones may be preserved advantageously, it is more convenient for the purposes of a general view to unite the whole pine belt, which I propose to do under the name of the Nevadan area.

Above it the Arctic flora is feebly represented; and by it the remaining territory is divided into two life-areas. The Desert area comprises the deserts north and east of the Nevadan Range; the district between that range and the sea may be designated as the Cismontane area.[18] It remains to consider the character and limits of these several divisions, and of their subdivisions.

THE ARCTIC-ALPINE ZONE.

As has been stated already this zone is represented only on the summits of the two highest mountains, Grayback and San Jacinto. And it is but the scanty vestiges of an Arctic flora that lingers on these lofty summits, much scantier than their altitudes would justify one in expecting, even taking into consideration that this is the southern known limit of the Arctic flora on the North American continent. The summit of Grayback is flat and consists of porous decomposed granite, unfavorable to the growth of plants. San Jacinto is more fortunate, having on its precipitous northern face some steep, shaded cañons, preserving perpetual snows. But for all that, it does not exceed in species its less favored neighbor. A single species, *Ranunculus Eschscholtzii*, has been found on both peaks, *Arenaria hirta verna* and *Antennaria alpina* have been collected on Grayback, while from San Jacinto *Carex Preslii* and *Oxyria digyna* have been added to the short list. Further explorations may be expected to increase it, but not greatly.

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[18] This has been designated usually as the Intramontane area, but the present term seems preferable.

THE NEVADAN AREA.

The lower limit of this area coincides with that of *Pinus ponderosa*. On cismontane slopes this is seldom below 5,000^{ft} (1,524^{m}) altitude; but on the opposite side the influences of the desert force it up to 6,000^{ft} (1,828^{m}), and even to 7,000^{ft} (2,133^{m}) above sea level. This region contains the only real forests in the entire territory, and while these are far inferior to those in the damper and cooler parts of the Pacific Coast, they are by no means insignificant, either in extent, or in the size and variety of the trees which compose them.

As already stated the zones which I have included in this area are much confused. Perhaps the best marked is the Hudsonian, which we may consider as indicated by the presence of *Pinus flexilis*. This is known to occur on Grayback, San Jacinto, and Santa Rosa peaks, and it should be found on one or two other high summits. As a zonal index its proper limit would be between 9,000 or 10,000 to 12,000^{ft} (2,750–3,650^{m}). But under favorable conditions it descends 1,000–2,000^{ft} (300–600^{m}) lower into the Canadian, and in at least one instance an isolated Hudsonian "island" occurs at 6,500^{ft} (1980^{m}), well down in the Neutral or Transition zone.[19]

The Canadian zone, which may be taken as indicated by *Pinus Murrayana*, is even less definitely marked. This pine is not uncommon in places as low as 6,500^{ft} (1,980^{m}), but it is better developed in moist valleys 1,000–2,000^{ft} (300–600^{m}) higher, and becomes more abundant as one ascends, until it mingles with the limber pine of the superior zone.

But the most important zone is the Neutral, or Transition; and it is the only one represented in the greater part of the Nevadan area. The principal tree throughout this zone is *Pinus ponderosa*. Its lower limits have been specified, and its upper limit may be placed at 8,500^{ft} (2,590^{m}), or occasionally, and under favoring conditions 500–1,000^{ft} (150–300^{m}) higher.

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[19] For an account of this see "The Flora of Snow Cañon, California," by the writer, in Plant World 4 : 227.

With this species is intermixed a considerable proportion of *Abies concolor*, *Libocedrus decurrens*, *Pinus Lambertiana* and some *P. ponderosa Jeffreyi*, without zonal differentiation, except that the Abies is more abundant and of greater size toward the upper limit, at 7,500–8,000^{ft} altitude (2,286–2,438^{m}).

On each slope of the mountain there is, beneath the Pine or Neutral zone, an intermediate, or true Transitional zone. The one differs entirely from the other, each possessing plants peculiar to itself and also representatives of the superior and the inferior zones. On the desert side this zone is nearly crowded out, and is present only in a narrow strip, between 6,500 and 7,500^{ft} (1,980–2,286^{m}) altitude, along the northern slope of the San Bernardino Mountains, and reaching from Bear Valley some fifteen miles towards Cajon Pass. It is indicated by an abundant growth of *Juniperus Californicus* and *Cercocarpus ledifolius*. It is much intruded upon by the plants of the zones above and below it, and within its limits may be seen in juxtaposition such incongruous species as *Pinus ponderosa* and *P. monophylla*, *Abies concolor* and *Yucca brevifolia*.

Of this transitional character, also, is the belt of *Pseudotsuga macrocarpa* and *Pinus Coulteri*, extending along the cismontane flank of the Nevadan Range, at 3,000–4,500^{ft} (915–1,370^{m}) altitude. The former is more abundant at the northern part of the belt, and the latter at the south, where it occupies a position similar to that of the closely allied *P. Sabiana* in the foothills of central California. To the north *Pinus Coulteri* is commoner on the lower ridges within the *P. ponderosa* zone.

The following table shows those genera which, in our territory, are found only in the Nevadan area.[20] Genera which are abundant and widely distributed are in SMALL CAPITALS; those local and rare in *italic*.

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[20] In this, and in subsequent tables of regional distribution those genera are omitted which are represented by endemic species only. Want of space prevents an extension of this investigation to the species of such genera as have representatives in more than one area, but its extension to these would be found to reinforce the conclusions reached. In determining the sources, or geographical affinities, of the elements composing the floras of the different areas, regard is had, not to the distribution of the genus as a whole, but of the particular species under consideration.

GENERA FOUND ONLY IN THE NEVADAN AREA.

Exclusively Nevadan		Boreal	
LIBOCEDRUS	Heracleum	Athyrium	Pterospora
Danthonia	*Pyrola*	*Woodsia*	Geum
Hemicarpha	*Chimaphila*	CYSTOPTERIS	HYPERICUM
VERATRUM	SARCODES	*Cryptogramma*	Circæa
Iris	Rhododendron	ABIES	Hippurus
Corallorhiza	*Brianthus*	Alopecurus	Myriophyllum
CASTANOPSIS	*Cycladenia*	Glyceria	Gentiana
SPRAGUEA	*Boschniakia*	Puccinella	*Polemonium*
Lewisia	KELLOGGIA	*Trisetum*	Lappula
Heuchera	Hemizonella	Luzula	Taraxacum
Philadelphus	Hulsea	Smilacina	Crepis
Heterogaura	*Raillardella*	Actæa	Hymenopappus
Sphænosciadium		BARBAREA	Arnica

In the first two columns are placed those genera which, as to the species by which they are here represented, belong exclusively to the flora of the Sierra Nevada; in the last two those which have a more or less wide distribution throughout the whole Boreal province. But it is to be noted that every genus, without exception, has for its representatives in our flora the identical species which are found in the more northern parts of the Sierra Nevada. Moreover, with the exception of eight of the Nevadan genera and three of those of wider distribution,[21] all belong in the so-called Neutral or Transition zone.

From a consideration of this table it is evident that the flora of these southern mountains coincides with that of the general Sierra Nevada, of which it is physiographically a part. And so far as its position in the phytogeography of North America is indicated by distinctive genera, the Transition zone is preponderately Boreal rather than Sonoran.

THE DESERT AREA.

The Desert area consists of two very distinct subareas: the Mojave subarea, which includes all the country to the north and east of the San Bernardino and Chuckawalla Mountains; and the Colorado subarea, which consists of the great desert valley between the Chuckawalla Mountains and the southern prolongation of the main range. These are locally known as the Mojave and the Colorado Deserts.[22] These two subareas have many plants which are common to both, but each possesses also a distinctive flora. These characteristics, so far as they relate to genera, are exhibited in the subjoined table.

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[21] Namely: *Castanopsis, Philadelphus, Pyrola, Chimaphila, Bryanthus, Cycladenia, Boschniakia, Raillardella, Athyrium, Woodsia, Cryptogramma.*

GENERA PECULIAR TO THE DESERT AREA.

COLORADO SUBAREA	MOJAVE SUBAREA	BOTH SUBAREAS
Northeastern Element	Northeastern Element	Northeastern Element
Astephanus	_Actinella_ Amsonia Atrichoseris *Bouteloua Cleomella *EUROTIA _Forestiera_ Glossopetalon Glyptopleura KOCHIA LYGODESMIA Monoptilon Phellopterus PURSHIA STANLEYA *Salazaria *Syntrichopappus	Anisocoma Grayia Piptocalyx _Tricardia_
Southeastern Element	Southeastern Element	Southeastern Element
WEDELIA *Argythamnia _Ayenia_ *Beloperone Boerhaavia *_Calliandra_ *Cercidium Chloris *_Condalia_ Dicoria *Fagonia Fouquiera *Hibiscus *Horsfordia *Hoffmanseggia *HOFMEISTERIA *HYPTIS *Leptochloa _Martynia_ *Olneya *Parkinsonia _Pectis_ *Peucephyllum *Palafoxia *Porophyllum Sesbania *_Triodia_ _Tribulus_ Trixis *Washingtonia	_Canotia_ Coleogyne _Fallugia_ _Psilactis_	Acamptopappus Achyronichia Baileya Bernardia Cladothrix HILARIA *KRAMERIA *LARREA Mohavia Nolina THAMNOSMA Trichoptilium
		Indefinite
		Calycoseris Chylisma *Dalea *Ephedra PETALONYX Psathyrotes Sphaeralcea

It appears by this table that the desert genera fall into three nearly equal groups: namely, those which are found only in one or the other of the two subareas, and those which occur in both of them. I have separated the genera of each group into two sections; a northeastern section for those whose extensions are into Nevada, Utah, and the Great Basin life-area; and a southeastern section to include those whose extensions of range are into Arizona, and towards or into northern Mexico. There remains a group in the third column whose affinities cannot be stated definitely, mostly because represented by more than one species which have diverse ranges. Genera which are represented by species which also extend into the peninsula of Lower California are distinguished by an asterisk. Washingtonia has its only extension in that region.

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[22] The region bordering the Colorado River is too little known to permit exact statements regarding it. There are reasons for believing that the Colorado subarea should include the interval between the river and the eastern slope of the Providence Mountains.

It is to be noted that Astephanus, the single northeastern genus peculiar to the Colorado subarea, is known from a single collection. All the others are southeastern, and all but ten extend into Lower California. On the other hand Canotia and Fallugia, two of the southeastern plants of the Mojave subarea, are found only in the Providence Mountains, which may belong to the Colorado subarea. Only four of the peculiar Mojavan plants have been reported from Lower California.

Like geographical affinities are exhibited by the different species of certain genera which are differently represented in each subarea. A longer list than the following might be compiled, but these examples must suffice.

DISTRIBUTION OF CERTAIN DESERT SPECIES.

Colorado Subarea	Mojave Subarea
Agave *deserti	Agave utahensis
Aster Orcuttii	Aster tortifolius
Cassia *Covesii	Cassia armata
Coldenia canescens	Coldenia Nuttallii
—— *Palmeri	
Dalea *Emoryi	Dalea Fremonti
—— Parryi	—— polydenia
—— *Schottii	
—— *spinosa	
Gilia *bella	Gilia dichotoma
—— *Schottii	—— Matthewsii
—— *tenuifolia	—— setosissima
Lupinus arizonicus	Lupinus brevicaulis
Pentstemon ambiguus	Pentstemon glaucus
Phacelia micrantha	Phacelia Ivesiana
Psathyrotes *ramosissima	Psathyrotes annua

All the species in the Colorado column have southeastern affinities; all those in the Mojave column have northeastern affinities. In the former, ten out of sixteen extend into Lower California; in the latter, none.

The distribution of the desert flora, and fauna as well, is not known, as yet, with sufficient exactness to permit positive statements. But facts already accumulated indicate that in the Colorado subarea the Lower Sonoran flora, which extends over the entire desert area, is very slightly modified by any other. The Mojave subarea, on the contrary, shows a marked influence from the Great Basin life-area. The limit to which this extends appears to be defined by the Chuckawalla Mountains.

While it is true that, within our territory, the general elevation of the Mojave Desert considerably exceeds that of the Colorado Desert, a difference having an undoubted modifying effect on their floras, yet the precipitation, the temperature, and other conditions of the two subareas are very similar. And the conclusions at which we have arrived would be strengthened were the investigation to be extended so far beyond our limits as to include the depression of Death Valley. Hence it may be inferred that the difference in the character of the two floras is only in part due to climatic causes, but is largely influenced by the topography of the region. In the one case a current of migration was able to pass up, encountering no physical barriers, from Arizona and Lower California into the Colorado Desert; in the other a current from eastern Utah and Nevada would meet no considerable obstacle until it reached the San Bernardino Range and its continuation.

The distinctness of the two subareas is further evident from a consideration of the zonal distribution of their respective floras. Much remains to be learned before these zones can be delimited accurately and finally; but sufficient data are at hand to permit their general disposition to be outlined, leaving the details for completer knowledge.

The Larrea belt, which is considered as indicating the limits of the Lower Sonoran, is present in both deserts. But however useful this shrub may be as the biological index of larger divisions, it is of less importance in the study of smaller areas. Within these narrower limits it is probable that more than one subzone may be traced, but much fieldwork must be done before this can be accomplished satisfactorily. There are indications, however, in the Colorado Desert of a subzone below the Larrea, whose limits appear to be traceable by the growth of *Atriplex polycarpa*. But for the present the Larrea zone may be taken as a whole, and considered as extending over all parts of the two deserts below 3,000$^{\mathrm{ft}}$ altitude (915$^{\mathrm{m}}$).

Above the Larrea, the zones of the two deserts, although analogous, are indicated by entirely different plants. In the Mojave Desert the first zone above is that of *Yucca brevifolia*. This belongs properly between 3,000 and 4,000$^{\mathrm{ft}}$ (915–1,220$^{\mathrm{m}}$) altitude; occasionally, however, it descends 500$^{\mathrm{ft}}$ (150$^{\mathrm{m}}$) lower, or again carries its characteristic species as high as 7,000$^{\mathrm{ft}}$ (2,133$^{\mathrm{m}}$). In its normal limits *Juniperus californica* is mingled with the Yucca, but does not accompany it far above them. The principal belt of this zone, beginning at the upper end of Antelope Valley, follows the base of the San Bernardino Range to Warrens Wells, and thence, along the Chuckawalla Mountains, at least to Virginia Dale. A less important belt extends from Daggett to Pilot Knob.

Above the first named Yucca belt is the Piñon zone, marked by the presence of *Pinus monophylla*, having an altitudinal breadth between 4,000 and 6,000$^{\mathrm{ft}}$ (1,220–1,830$^{\mathrm{m}}$). It also begins in Antelope Valley, and extends, but with considerable interruptions, from Gormans Station to and beyond Warrens Wells, and possibly even to Virginia Dale.

In the upper end of Antelope Valley the orographical confusion which there exists has given rise to a curious phytogeographical anomaly. Here *Pinus Sabiniana*, *Quercus Douglasii*, and *Q. Wislizeni*, trees characteristic of the western slope of the Sierra Nevada throughout central California, coming through Tejon Pass, find themselves on the *eastern* slope of that range, and the unusual sight is presented of desert foothills clothed with an almost unmixed growth of scrub-oaks. Here, too, are found *Aesculus californica*, *Balsamorhiza deltoidea*, *Gilia tricolor*, *Layia* *heterotricha* and *Collinsia Torreyi*, which have entered through the same gate to share the anomalous position of the oaks.

In the Colorado Desert the Yucca zone is replaced by a well-defined zone of *Agave deserti*, which, in an almost continuous belt between the altitudes of 2,500 and 4,000 $^{\mathrm{ft}}$ (760–1,220 $^{\mathrm{m}}$), stretches along the desert slopes of the mountains from San Jacinto Mountain to and beyond the Mexican boundary. The plants of that zone, with inconsiderable exceptions, are quite distinct from those of the corresponding Yucca zone of the Mojave Desert, although it has the same altitudinal limits, and other physiographical conditions.

Above this Agave zone there is a little known Piñon zone. It begins southeast of San Jacinto and extends to El Toro Mountain, above Toros, its upper limit being about 5,000 $^{\mathrm{ft}}$ (1,525 $^{\mathrm{m}}$) above sea level. Possibly, in the little-explored mountains between El Toro and the Mexican line, other traces of this zone may connect it with the extensive nut-pine forests of the peninsula. At its upper end this belt is mainly composed of *Pinos monophylla*, while on El Toro, *P. Parryana* has supplanted it.[23]

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[23] These two species appear either to coalesce, or to hybridize, in this belt. Specimens may be found in which there are, on the same twig, sheaths containing two, three, or four leaves.

[*To be concluded.*]